

RELICT STANDS OF PINYON HYBRIDS IN NORTHERN UTAH^{1,2}

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ABSTRACT.— Relict stands of *Pinus edulis* and *P. monophylla*, and of natural hybrids of these species have been found in Cache and Rich counties. The stands and their sites are described. The *P. edulis* stand in Rich County extends the range of this species northward. Possible means of seed dissemination are discussed and it is speculated that both species formerly migrated into and out of this area during periods of differing climates.

Two pinyon pine species are native to Utah: pinyon (*Pinus edulis* Engelm.) and singleleaf pinyon. (*P. monophylla* Torr. & Frém.). Pinyon is typically a species of the Colorado Plateau, while singleleaf pinyon is characteristic of the Great Basin. Cole⁴ postulated that the two species hybridize along an ecotone running north and south through central Utah. Recent field studies have confirmed that these pines hybridize along the eastern edge of the Great Basin and in other areas where their ranges overlap (Lanner, 1971).

Hybrid segregates have also been discovered in Cache and Rich counties, in a series of relict stands previously thought to be well outside the range of *P. edulis* (Critchfield & Little, 1966). The evidence for hybridization will be fully covered in a later paper. Major criteria are number of needles per fascicle (*P. edulis* = 2; *P. monophylla* = 1; hybrids have fascicles of both types) and number of resin canals per needle (*P. edulis* = 2; *P. monophylla* = 2 - 10; hybrid means are intermediate). The aims of this paper are to describe the northern relicts and to explain their supposed origin.

THE POPULATIONS

Four of the relict stands are in Cache County, and one is in the Crawford Mountains of Rich County.

1. *Mt. Logan*. Eleven trees on a spur between Logan and Dry canyons, in Sec. 31 and 32, T12N, R2E, Cache National Forest. Of 10 trees examined, 8 appear to be pure *P. monophylla*, but the others have 11-35 percent of their foliage in fascicles of two.

2. *Logan Canyon*. Two trees located 2 miles NE of the above population, in Sec. 29, T12N, R2E, Cache National Forest. Both appear to be pure *P. monophylla*. Reported presence of additional trees is unverified.

3. *Blacksmith Fork*. Many trees scattered in drainage of Mollen's

¹This research is supported by funds provided through the McIntire-Stennis Cooperative Forestry Research Program. It is approved as journal paper no. 1270 of the Utah Agricultural Experiment Station.

²An abstract of this paper was presented at the Utah Academy of Sciences, Arts, and Letters meeting at Logan in September 1971.

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⁴Cole, Franklin R. The pharmacognosy of Utah pinyon pines. Doctoral dissertation, University of Utah, 1965.

Hollow, Sec. 27, 28, 29, 32, 33, 34, T10N, R4E, Cache National Forest. Most are pure *P. monophylla*, but some have up to 68 percent of their foliage in fascicles of two.

4. *Porcupine*. At least 29 trees, N of Porcupine Reservoir in Sec. 10 and 11, T9N, R2E. Trees range from pure *P. monophylla* to individuals with 90 percent of their foliage in fascicles of two.

5. *Crawford Mountains*. Eleven trees were sampled 4 miles E. of Randolph in a box canyon on the western scarp of Rex Peak in Sec. 30, T11N, R8E. Trees range from pure *P. monophylla* to pure *P. edulis*, with individuals of intermediate character.

Unlike the other populations, this is mainly a *P. edulis* stand and represents the northernmost limit of the species.

Locations are given in reference to the Salt Lake Meridian. They fit within a rectangle 34 miles long (E - W) and 15 miles wide (N - S), the NW corner of which lies at 41°45'30"N and 111°45'30"W; and the SE corner at 41°31'30"N and 111°05'30"W.

GROWTH HABITS

The relict stands consist of small groups of relatively slow-growing trees. They are usually on south-facing slopes within a narrow elevational range and associated with tree species that characterize the transition from relatively xeric to subhumid conditions (Table 1). The pinyon pines seem unable to compete with lush north-slope tree and brush cover and are mainly restricted to drier aspects where plants are widely spaced between large areas of bare ground. The limited area of these stands and their age distribution suggests a precarious balance between survival and extinction. Though regeneration is sporadic, some trees are long-lived and have many opportunities to reproduce (Table 1). It is possible that the *P. edulis* trees, growing at the northern limit of their range, may be reproductively impaired by pollen that is rendered inviable by low temperatures at critical times in its development (Chira, 1967). In very small populations, the high incidence of self-pollination may result in the production of inviable seed or nonvigorous seedlings.

ORIGINS

The nearest station of *P. monophylla* is in the Black Pine Mountains of southern Idaho, about 70 miles WNW of Logan.⁵ The nearest *P. edulis* stands are about 100 miles S of Randolph, in the Uinta Basin. The disjunct stands are either old relicts, left behind by widespread extinction, or they represent new invasions.

Invasion seems unlikely. Pinyon pine seeds are wingless, heavy, and ballistically unadapted to wind dissemination. Experiments in this laboratory by R. Warnick indicate that a wind of 100 mph is required to carry *P. monophylla* seeds 30 ft downwind from the

⁵Critchfield and Little (1966) show *P. monophylla* extensively distributed in the northern Wasatch, straddling the Utah-Idaho state line, but this report appears to be in error.

TABLE 1. Some characteristics of relict pinyon pine stands in northern Utah.

Location	Elev. (ft)	Aspect	Tree Associates	Range of Estimated Tree Ages ¹ (years)	Maximum Heights (ft)	Maximum Stem Diam. (in) ²	Date of Anthesis 1969
Mt. Logan	6500	S	<i>Juniperus osteosperma</i> <i>Pseudotsuga menziesii</i> <i>Cercocarpus ledifolius</i>	92-262	35	20	20 June
Logan Canyon ³	6500	S		90-143	35	15	-
Blacksmith Fk.	6000- 7300	S,E,W	<i>J. osteosperma</i> <i>J. scopulorum</i> <i>P. menziesii</i> <i>C. ledifolius</i> <i>Pinus flexilis</i> <i>Populus tremuloides</i> <i>Acer</i> sp.	-	-	-	27 June
Porcupine	6000- 6500	S,SE	<i>J. scopulorum</i> <i>P. menziesii</i> <i>C. ledifolius</i> <i>P. flexilis</i>	67-314	35	48	20 June
Crawford Mts.	6800- 7300	N,S,W	<i>J. osteosperma</i> <i>J. scopulorum</i> <i>P. menziesii</i> <i>C. ledifolius</i>	120-426	25	22	20 June

¹Rings at breast height plus 50 years; at several locations there were younger trees too small to bore.²Diameter at 4.5' above ground.³Data supplied by C. M. Johnson.

top of a 30-ft tree. Long distance dispersion by birds or mammals, though a possibility, seems unlikely to account for two tree species on sites far removed from both present distribution areas, one to the west, the other to the south.

The movement of seeds by man is a possibility worth consideration. Wright⁶ concluded that a disjunct *P. edulis* stand in Owl Canyon, near Fort Collins, Colorado, resulted from "accidental or intentional planting that took place approximately 400 years ago" along an ancient Indian trail. Acceptance of this interpretation has led Weber (1961, 1965) to explain other trees subsequently found nearby in the Rockies as having originated from seed transported there, by birds, from the Owl Canyon grove. It seems equally logical to consider all the northeast Colorado pinyon locations as relicts of a once-continuous distribution from the south, but the evidence on this point is by its very nature inconclusive.

In the present case, man seems an unlikely agent. The Paiute and Shoshoni of the Great Basin often set up their temporary winter villages in pinyon pine areas, in order to take advantage of the pine-nut crop (pers. comm. Prof. Julian H. Steward, Univ. of Illinois). Thus, the Indians went to the trees, rather than attempting to plant them. The pinyon stands at Mt. Logan and Logan Canyon are on steep ridges, unsuitable as travel routes or campsites where caches might be established. And, again, the coincidence of establishing two species on the same sites seems farfetched.

We lean toward an explanation based on paleoclimates. There is a rough parallel here with the situation described by Cottam et al. (1959). According to their analysis, hybrid clones of *Quercus gambelii* Nutt. and *Q. turbinella* Greene originated early in the latest postglacial period, when warmer climates in the north permitted *Q. turbinella* to persist well outside its present range. Using a similar line of reasoning, we propose the following sequence of events to account for the pinyon pine relicts of northern Utah:

(a) *P. monophylla* migrated into the northern Wasatch and Crawford mountains at a time when it was cooler and moister than now. At this time, *P. monophylla* may have been continuous along the north rim of the Great Basin from the Raft River Mountains, across the low hills on the north shore of Lake Bonneville, to the Wasatch.

(b) *P. edulis* migrated north on the Wasatch from the Uinta Basin when it was warmer than now. The species interbred. It is interesting in this connection that an outpost of Gambel oak has been found several miles east of the Porcupine location where there are trees appearing to be nearly pure *P. edulis*. In the Uinta Basin these species are sometimes associated with each other.

(c) Later changes caused the following to occur:

i. *P. monophylla* became extinct at lower elevations, leaving

⁶Wright, C. W. An ecological description of an isolated pinon pine grove. Master's thesis, University of Colorado, 1952.

populations that have survived to become its major stands on the Great Basin ranges, and relicts on the Wasatch.

ii. *P. edulis* retreated southward, persisting in a few suitable areas where competition was less severe. Thus, both species are present only as relicts. The species have an overlapping range of tolerance to environmental conditions, as attested by their frequent sympatry, so it is not surprising they should share common refugia. Admittedly, this interpretation of these relict stands is speculative, but other interpretations require assumptions that are equally speculative.

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